Galway City Council

Comhairle Cathrach na Gaillimhe
Galway City Council

ARUP

The Roadmap for Grattan Beach and Dune Site

Contents

Executive Summary

The Roadmap for Grattan Beach and Dune site (Grattan Beach) sets out the vision for Grattan Beach as a living lab and national demonstration site for Nature-based Solutions (NbS) to tackle the societal challenge of climate change. It has been informed through an engagement process with local stakeholders and citizens.

The Roadmap presents future visions for Grattan Beach which involve a flexible management approach, based on experimentation, learning, reflexivity, and reversibility. The three 'wished for' Visions are:

1. In one years' time, Grattan Beach continues to be used all year round. The City Council has developed a Grattan Beach management plan and restoring the dune ecosystems is a priority. Way-finding deters people from walking over the dunes and explains the factors that lead to erosion. New routes have improved access to the Grattan Beach and chestnut paling has been installed to encourage embryonic dunes to develop. Where possible seaweed is left on the beach as it is an important part of the Grattan Beach ecosystem.
2. In three years time, Grattan Beach is a place that brings community together. Observed climate change has led the community to focus on solutions to erosion and flooding and develop a healthy habitat for sustainable use. Where possible Nature-based Solutions as the preferred option, but in some instances hard solutions are necessary. The community use Grattan Beach in diverse ways including for education, research, sport, recreation and activism.
3. In thirty years time, Grattan Beach is narrower than it used to be due to the impacts of climate change. The habitat continues to provide coastal protection to residents. A flexible management approach has been taken which has been informed by long term flood risk studies. Grattan Beach is a living lab for experimenting with and showcasing Nature-based Solutions.

The visions were developed from stakeholders' inputs gathered during future-thinking workshops. Three workshops were held with non-government organisations, government bodies, statutory authorities, and the local community. The lead question for the development of the scenarios was "what do stakeholders and the community want their future Grattan Beach to be like?". Once the visions for the short, medium, and long-term, 2024, 2027 and 2054 respectively, were developed a backcasting approach was used to work backwards from each vision to develop actions and milestones along a pathway that connects to the present.

Stakeholder engagement revealed that the key challenges and opportunities related to facilities and amenities, access and accessibility, seaweed management, and addressing societal challenges. Stakeholders' visions for Grattan Beach focused on community engagement and changes to the structure and quality of the ecosystem, access, new and different uses, and the maintenance and management of the Grattan Beach.

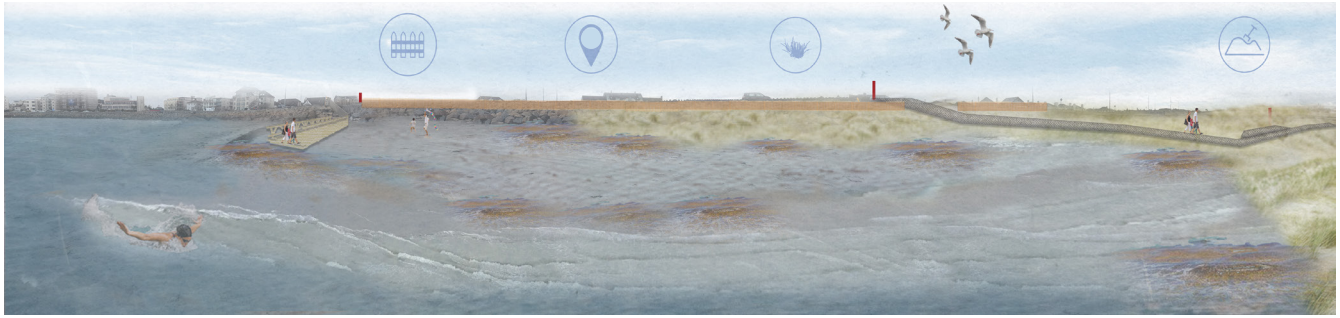
Grattan Beach changes with the tides and the seasons and is influenced by the people who love and use it. Nature-based Solutions will form an important part of the Grattan Beach's future. All of the objectives proposed through the community vision, partnerships and plans will be implemented and achieved through the establishment of a Living Lab; where scientists find solutions to problems in the real world by working with other experts and the public, at Grattan Beach.

Executive Summary

Future vision: In one year's time…

Future vision: In three years' time…

Future vision: In 30 years' time…



Under the IPCC's Sixth Assessment Report's (AR6) 'middle of the road' scenario (SSP2-4.5) global warming will hover around current levels, starting to fall mid-century; net zero is not reached by 2100. If under this scenario, global warming of 2°C is extremely likely to be exceeded. This scenario could be considered a 'most probable' scenario, but it does require existing commitments/ targets to be achieved.

1. Introduction

1. Introduction

This Roadmap for Grattan Beach and Dune Site (Grattan Beach) has been created by Arup on behalf of Galway City Council (GCC). The Roadmap is informed through an engagement process with the stakeholders and citizens of Grattan Beach and Galway City throughout November and December 2022.

GCC's objective is to develop Grattan Beach as a living lab and national demonstration site for Nature-based Solutions (NbS) to tackle the societal challenge of climate change.

Grattan Beach is a sandy beach and sand dune close to Salthill in Galway City (Figure 1). The Grattan Beach site is partially within European areas of designation (Figure 2). The Galway Bay Complex proposed Natural Heritage Area (pNHA) extends to the upper beach. The Galway Bay Special Protected Area (SPA) and Galway Bay Complex Special Area of Conservation (SAC) extend to the middle of the beach. The Habitats Directive Annex 1 habitats "Mudflats and sandflats not covered by sea water at low tide [1140]" and "Reefs [1170]" both occur within Grattan Beach. Grattan Beach provides a range of benefits including the support of biodiversity, recreation, leisure, and general wellbeing.

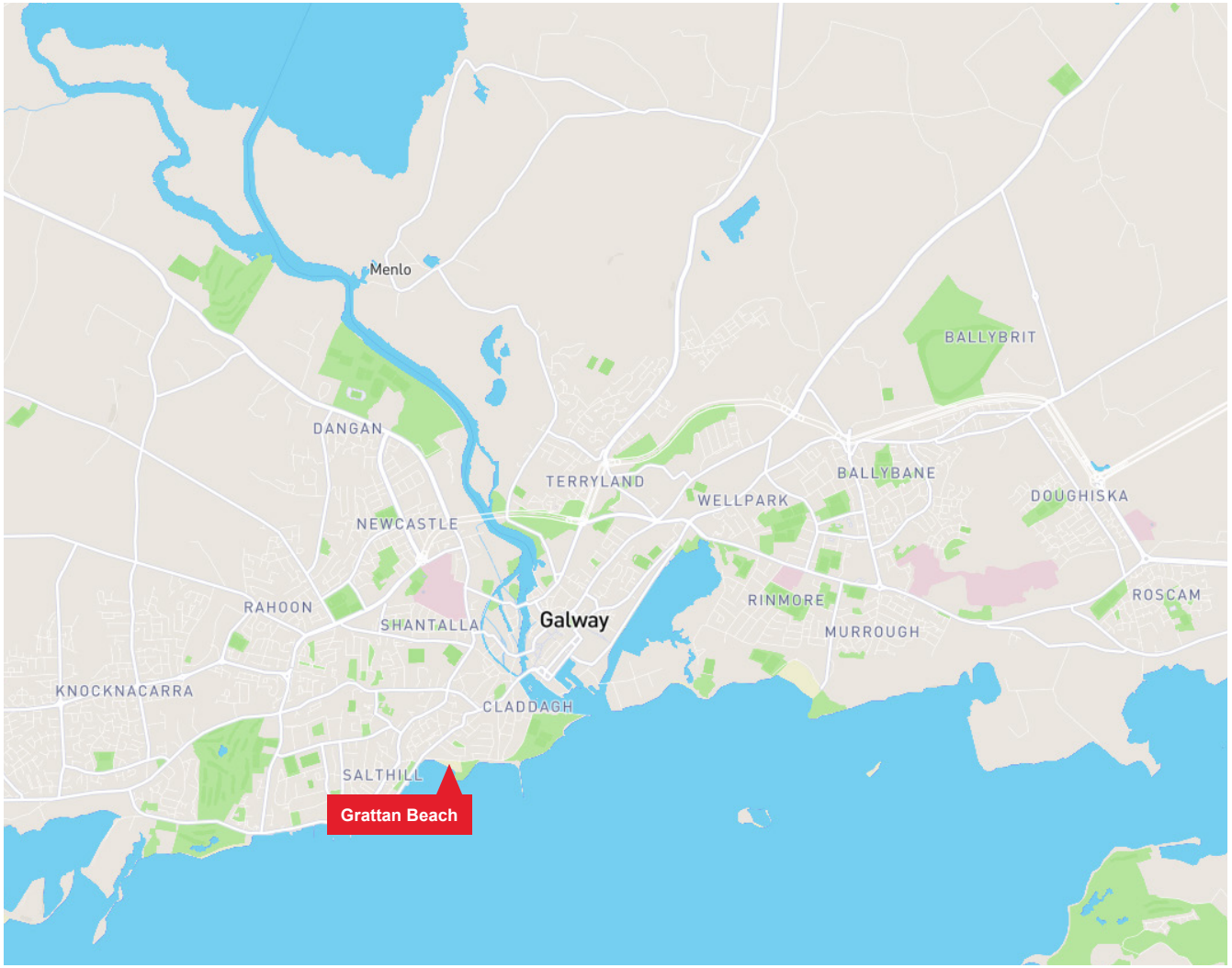


Figure 1 Map of Galway City showing Grattan Beach

Figure 2 Map of Grattan Beach showing SPA, pNHA, and SAC. Green layer shows SPA, pink pNHA and orange SAC, a blue polygon denotes the beach and dune area. The SPA encompasses the lower beach. The pNHA encompasses the lower and upper beach. The SAC encompasses lower and upper beach and dune. Source: EPA Maps1

Our changing climate

Coastal flooding and erosion pose threats to Grattan Beach and the surrounding areas. In Irish waters the sea surface temperature has increased at a rate of approximately 0.6 °C per decade since 1994, which is unprecedented in the 150-year historic record.[2] Coastal flooding occurs when high tides and surges inundate coastal areas. Coastal erosion, which is closely linked to coastal flooding, takes place when the sea increasingly encroaches upon the land. Rates of land loss for Ireland from erosion and flooding between 1991 and 2008 have been estimated to be approximately 1.6 km^2/annum.[3]

The climate crisis will have a wide range of negative impacts on coastal ecosystems including sea level rise and the increased frequency and severity of coastal storms.[2] By 2050, 15% of the world's sandy beaches will be experiencing 'severe erosion' and by 2100 'severe erosion' is expected to impact 35-50% of sandy beaches.[4] Up to 15% of the world's sandy beaches face "severe erosion" by 2050, with this rising to 35-50% by the end of the century. In the North Atlantic region, the number of intense storms are anticipated to increase as a result of the winter path crossing over Ireland more often with Grattan Beach feeling the impact of these storms.[2] Galway city's coastal location means that it is subject to tides, and any significant rise in sea levels will have major economic, social, and environmental impacts. Grattan Beach faces future challenges such as continued erosion, sea level rise and warming sea surface water temperatures which may result flooding and damage to nearby property and infrastructure.

Nature-based Solutions for Grattan Beach and dune site

Global warming is changing weather patterns, resulting in sea level rise and an increased number of extreme weather events. Nature-based Solutions (NbS) can help communities to adapt to, and mitigate against, the changing climate and help people and ecosystems to build resilience to climate-related hazards.

NbS are defined by the International Union for Conservation of Nature as *"actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits"*. NbS can provide environmental benefits including flood water storage, habitat creation and improved air quality. They are also important solutions for tackling the biodiversity crisis, sequestration of carbon, preventing erosion and filtering pollutants from the air and water.

In coastal environments, NbS are actions to protect, sustainably manage and restore coastal ecosystems to address societal challenges. Coastal NbS are based on the capacity of coastal ecosystems to sequester carbon and foster adaptation and resilience of communities and ecosystems by working as buffers against climate change impacts while improving wellbeing.

The challenge in defining a future roadmap for Grattan Beach is to ensure that it will be carefully managed and enhanced, and an appropriate balance sought between providing recreation and access and maintaining the integrity of the coastal ecosystem. This is especially important considering the projected population growth of 42,000 people by 2031 for the city, as outlined in Galway's Metropolitan Area Strategic Plan (MASP), which will need a sufficient scale and quality of open space.[5]

To ensure the success of NbS at Grattan Beach, the local community must be engaged in the decision-making process that informs future strategies and priorities, in order to create ownership and durability of the outcomes.

Co-creation with communities

The local community and stakeholders have a significant role to play in contributing to the future of Grattan Beach. Engagement with the community and stakeholders is essential to ensure their involvement in the decision-making process.

It is the intention of GCC to facilitate and empower the community and stakeholders to make a collective decision as to the best NbS for protecting Grattan Beach.

Grattan Beach as a Living Lab

Developing NbS requires a flexible management approach, which includes experimentation, learning, reflexivity, and reversibility.[6] To solve complex problems and find innovative designs, partnerships and collaborative approaches are key to the successful implementation of NbS.[7,8] To ensure the success of any proposed NbS at Grattan Beach GCC intends on establishing a Living Lab at the location.

A Living Lab brings research out of the lab or the classroom and into the real world by creating a user-centred, open, innovative ecosystem that engages communities and stakeholders in collaborative design and exploration.

Living Labs work to:

- provide a safe environment for learning-by-doing in a real-life setting
- provide opportunities for all stakeholders to share their ideas and preferences and decide on solutions that will later impact their lives
- facilitate collaborations between different stakeholders through co-creation
- focus on transparency, openness, collaboration, and dialogue between stakeholders of different experiences and expertise.

Living Labs usually follow a step-by-step approach. The three main phases are:[9]

1. Setup Phase – this is focused on understanding the challenge or problem and identifying the stakeholders who would collaborate on the problem;
2. Working Phase – this is centred on the development and testing of a solution;
3. Outcome and evaluation phase – this is dedicated to evaluation. The solutions are tested for usability, benefits, and acceptance. If testing shows that the outcome is not as anticipated, earlier steps can be repeated to achieve an acceptable outcome.

Additional steps which can be incorporated into the process include, replication, upscaling, and dissemination. Figure 3 shows the steps and interactions described.

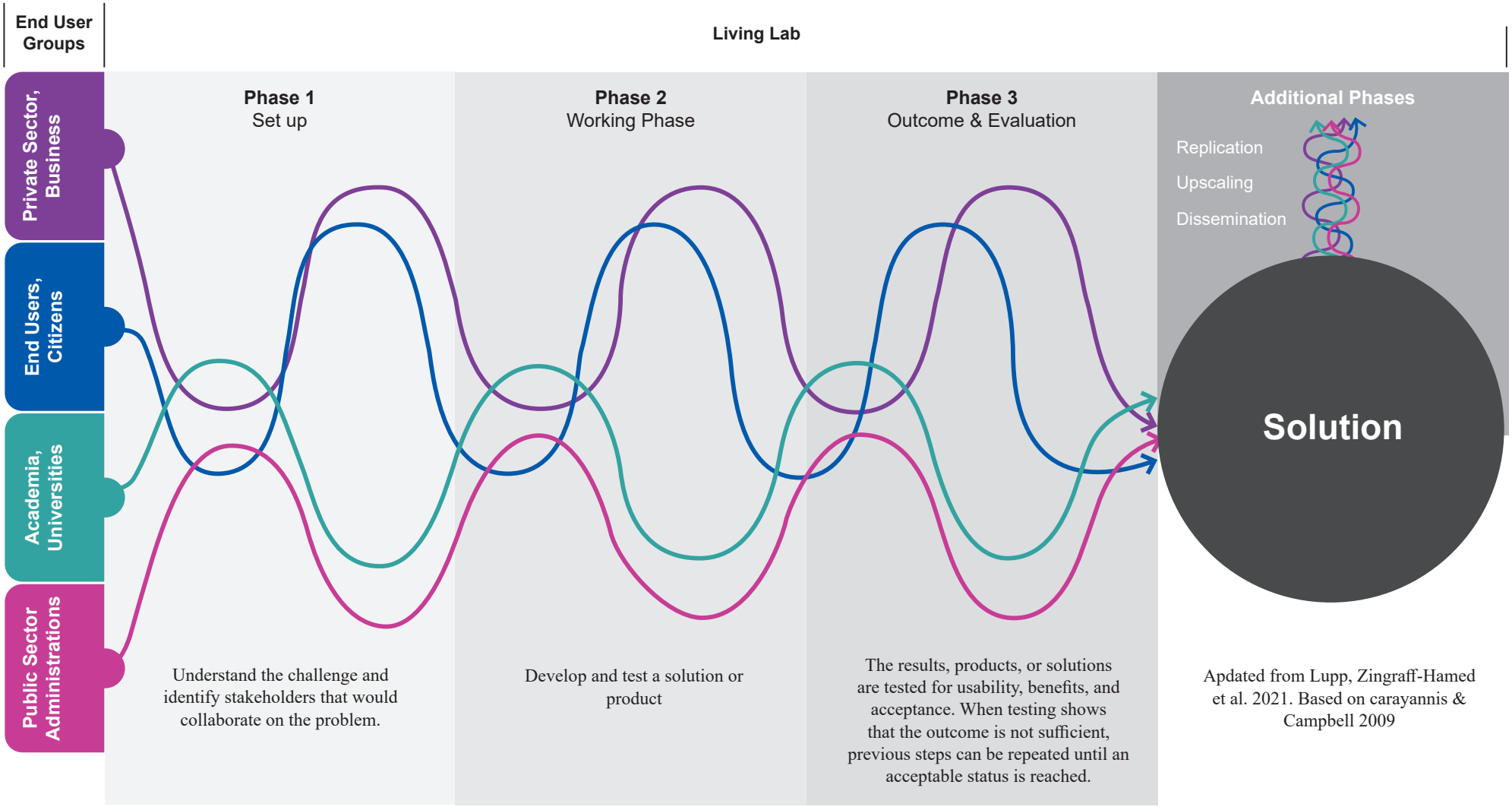


Figure 3 Living Lab steps based on Lupp, Zingraff-Hamed et al.9 and modified from the Quadruple Helix Innovation Model by Carayannis and Campbell[10]

GCC intends to apply a Living Lab approach for Grattan Beach that informs the design and implementation of NbS. Grattan Beach will be a demonstration site, that could be utilised as a showcase for NbS by other Local Authorities. It will facilitate the testing of solutions and projects and foster co-creation and open innovation among stakeholders, including facilitating knowledge exchange, joint actions, and partnerships.

The Living Lab process will enhance Grattan Beach as a tourist destination, bringing visitors to the local area, aquarium, and beach. It is intended that a Living Lab for NbS will inform the development of a Beach Management Plan, enhance the beach and dunes, and make Grattan Beach a national showcase for the best and most efficient process to successfully engage a community.

Evolution of the Roadmap

This Roadmap has been developed in close collaboration with GCC. The community and stakeholders were engaged from the outset of the project and their inputs have shaped the evolution of the Roadmap.

The Roadmap aims to provide a resource for GCC and decision makers working on Grattan Beach to guide investment decisions and the planning and implementation of NbS, with the primary objective being the protection and development of the beach and dunes. It is of value to GCC to support the development of Grattan Beach as a nature-based solution demonstration site and Living Lab.

The Roadmap presents scenarios that are, or may be deemed to be, forward-looking scenarios. By their nature, forward-looking scenarios involve uncertainty and subjectivity because they relate to future events and circumstances and are interpreted from the views and opinions of a group of people. The scenarios should only be considered as representative of desired futures or future visions. Actual events frequently do not occur as imagined, and the differences may be material. The desired futures may also change as people's views, opinions, and priorities evolve over time. For this reason, the scenarios included within the Roadmap are time-sensitive and relevant only to current conditions.

How is the Roadmap organised?

The Roadmap is organised into the following chapters:

Chapter 2

Project Methodology – This chapter describes the process for developing this Roadmap including a suite of relevant case studies.

Chapter 3

Findings – This chapter outlines the findings from stakeholder and community engagement workshops

Chapter 4

Future Scenarios – This chapter describes future visions for Grattan Beach for 2024, 2027 and 2054.

Chapter 5

The Roadmap – This chapter details a back-casting roadmap for the future based on the scenarios. It outlines a range of opportunities available

Chapter 6

Conclusion – This chapter offers the conclusions of the process.

Grattan Beach

2. Project Methodology

2. Project Methodology

Stakeholder mapping and analysis

GCC's vision for a successful and positive future roadmap for Grattan Beach requires a move to a climate resilient society and the inclusion of many actors, communities, and stakeholders.

GCC and Arup worked together to identify the collection of stakeholders to engage in this project.

To identify and understand the stakeholders who would be instrumental in shaping the future of Grattan Beach a broad cross-section of the community and a variety of stakeholders were considered. This approach ensured that a broad spectrum of stakeholders was identified and involved in engagement. Once an understanding of the communities' and stakeholders' interests had been established, it was possible to determine how to best communicate and collaborate with them.

The stakeholder list has been included in Appendix B. Stakeholders included:

- Individuals and groups within the community e.g. local residents groups, Serve the City, Access for All Galway;
- Groups or organisations which GCC partners with e.g. Mayo Climate Action Regional Office (CARO);
- •External stakeholders e.g. Birdwatch Ireland, University of Galway, The National Aquarium;
- Internal stakeholders e.g. Galway City elected Councillors.

Sub-categories of communities and stakeholders included:

- Communities and stakeholders of place: whose homes, workplaces, shops, and educational institutions are near Grattan Beach, or who use the beach for recreation.
- Communities and stakeholders of interest: such as people with different abilities and people from ethnically diverse backgrounds, people from different age groups, and people with various socio-economic backgrounds.
- Communities and stakeholders that form because of a specific issue: issues of particular concern such as litter on the beach, environmental protection, and community amenity.

Communities and stakeholders were clustered into three groups to facilitate the futures-thinking workshops. These groups were:

1. Government and statutory organisations.
2. Non-governmental and civil society organisations.
3. Other communities and stakeholders of place, interest, and issue.

Channels of engagement were established with the stakeholders. Invitations to participate in a workshop were issued via email and through GCC's channels and platforms of communication.

Grattan Beach

Futures-thinking workshops

A futures-thinking approach was taken to engagement to enhance trust and collective visioning. Futures thinking was included in the process by:

- Considering problematic trends like climate change
- Identifying strong influences stemming from the past
- Foreseeing emergent changes such as population growth
- Acknowledging the likelihood of unforeseen events
- Ensuring more equitable outcomes
- Anticipating the need to evaluate, monitor and revisit existing scenarios.

Three workshops were held, with invitations being issued to a total of 73 stakeholders. The first workshop was held online with stakeholders from non-government organisations on the 17th November 2022. The second workshop was also held online with stakeholders from government bodies and statutory authorities on the 24th November 2022. The invitees and attendees at each of the workshops have been listed in Appendix B. To frame the discussions Arup experts presented brief, accessible information to the participants of each workshop about the beach and dune ecosystems and geomorphology, NbS and Living Labs. Details of case studies presented at the workshops are included in Appendix B.

The workshop sought to gather knowledge and preferences on the following questions:

The third workshop was held in person in Salthill, near Grattan Beach, on the 7th of December 2022. The invitation was open to the community as well as the stakeholders who had participated in the first two workshops. Thirty-three people attended this workshop of whom three had previously attended one of the virtual workshops.

Integrating scientific knowledge, community knowledge, and preferences were essential considerations for the in-person workshop. Large maps of the Grattan Beach area were used for participatory activities to gather comments and inputs from stakeholders. This was a quick and accessible approach. The activity was undertaken in small roundtable groups. Aerial photographs provided a representation of place onto which the community could share their knowledge and visions about the past, present, and future of the beach. This mapping approach aimed to bridge the gap between top-down scientific information and community-based understanding of vulnerability and risk, and in doing so identified a range of potential solutions.

3

workshops held with non-governement ogranisations, government bodies and statutory authorities and the local community.

Developing future visions and a Roadmap to these futures

Scenarios are tools that can support strategic decision making. Visions can facilitate the imaginative exploration of different "wished for" futures and the descriptions of the roadmaps to these futures.

A normative scenario approach was taken for Grattan Beach as it focused on images of preferred (or "wished for") futures. These preferred futures were created following the three workshops with the community and stakeholders to provide a vision for GCC to guide planning and management processes for Grattan Beach.

The lead question for the development of this vision was "what do stakeholders and the community want their future Grattan Beach to be like?". This is distinct from questions like "what will their future (most likely) look like?" which would be used to development explorative scenarios to consider possible or probable futures.

How we constructed scenarios

To create a normative narrative scenario the following process was followed:

1. Definition and bounding – establishing the aim of the scenarios, their function, and audience
2. Future thinking workshops – described above, these focused on pinpointing the central content of the scenarios
3. Elaboration of the scenario expose – integrating the ideas generated at the workshops into the scenario background, seed visions, and first ideas for the plot of the vision, protagonists, and the style
4. Construction of the story board – developing the outline of the plot
5. Writing the scenario
6. Enriching the scenarios – incorporating feedback from GCC to amend any discrepancies and enrich the scenarios with ideas and visions that fit into the Grattan Beach setting.

Our research and workshops identified headline issues shaping the future of Grattan Beach. These have been outlined in Chapter 3. They were used to frame the differences between short-, medium-, and long-term visions, these relate to the years 2024, 2027, and 2054 respectively, looking 1, 3 and 30 years into the future. The dates are used to give a rough sense of time perspective and no specific focus should be put on those years.

The visions assume that climate change will align to the IPCC's Sixth Assessment Report (AR6) climate change scenario SSP2-4.5. The SSP2-4.5 scenario is considered the 'middle of the road' scenario for climate change. This climate change scenario expects continuation with existing announced commitments and policies, but more alignment with historic trends than future optimistic trends for human development. Under this scenario, global warming will hover around current levels, starting to fall mid-century; net zero is not reached by 2100. Under this scenario global warming of 2°C is extremely likely to be exceeded. This scenario could be considered a 'most probable' scenario, but it does require existing commitments/ targets to be achieved. [12]

How we constructed the Roadmap to the future scenarios

A backcasting approach was used. Backcasting looks back from the viewpoint of specific images of the future.[13]

The preferred futures identified in the scenarios were used and worked backwards to develop actions and milestones along a pathway that connects to the present. The obstacles and opportunities identified by stakeholders and the community during the workshops were used to inform these actions. Key milestones were defined and interim actions.

The backcast started from the vision for 2054. The 2024 scenario was not backcast since it was essentially an extrapolation of current trends and mainstream plans and projections and therefore could be considered like the baseline. The view was that this baseline would have changed by 2027 and give way to an alternative future and by 2054 the future would be transformed from the baseline. In the present, the alternative future is essentially ideas of what the next baseline could be.

3. Findings

3. Findings

This section outlines the outputs of the community and stakeholder engagement conducted as part of the project between November and December 2022.

Forty stakeholders shared their comments and visions. The activities undertaken in the workshops asked participants to share their answers to the following questions:

- How do you use the Grattan Beach and what do you value the most about it?
- What do you value about Grattan Beach and what are the opportunities?
- What do you think are the challenges and what would you like to see improved?
- What is your vision for Grattan Beach and Dunes?
- How do you measure success at Grattan Beach?

The following sub-sections presents key aspects of interests or concerns (both positive and negative) raised by stakeholders across the three workshops.

The community and stakeholder views expressed in this report do not necessarily reflect the views of Galway City Council or indicate a commitment to a particular course of action.

Usage and Values

Fifty-eight comments were received from participants on how they use the Grattan Beach on a regular basis. These comments were clustered into 11 use themes:

Land-based activities
Swimming
Education, research and engagement activities
Relaxation and Prayer
Walking
Water-based Activities
Exploring beach ecology and geology
Play
Amenity
Arts and Music
Stewardship

These themes were further coded by sub-themes. Figure presents the number of responses associated with each theme and sub-theme. Four sub-themes occurred five times or more, these are presented in Table 1.

Grattan Beach

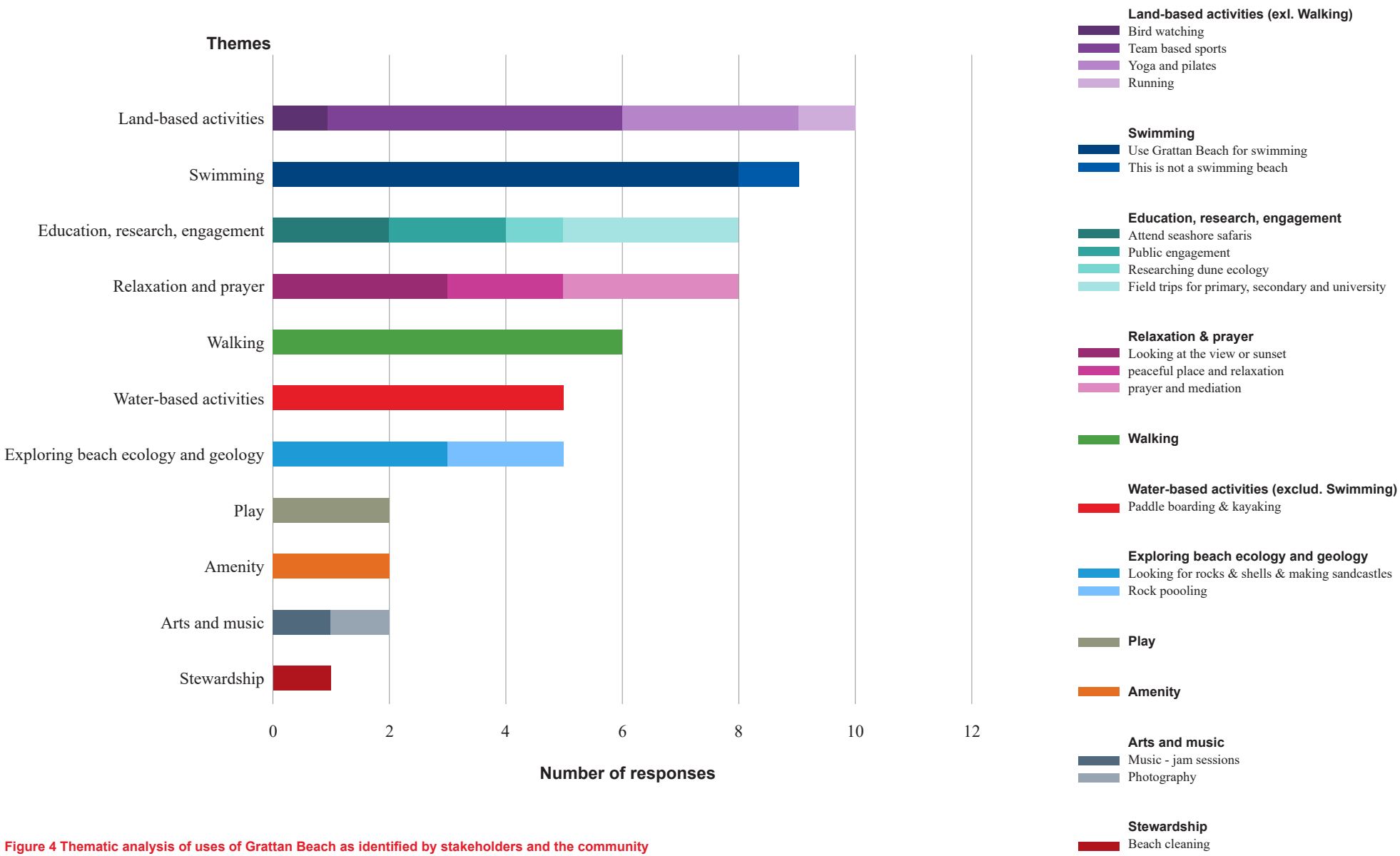


Figure 4 Thematic analysis of uses of Grattan Beach as identified by stakeholders and the community

Table 1 The most frequently occurring use sub-themes

Theme	Sub-theme	Number of responses
Swimming	Use beach for swimming	8
Walking	Walking	6
Land-based Activities	Team-based activities	5
Water-based Activities (excl. swimming)	Paddle boarding and kayaking	5

The following comments are considered representative of those received:

> “ The large community who cares about and uses the beach is inspiring. This is an untapped resource that can be developed to protect the beach and build a shared ownership of the area” Participant, Focus Group 2.

> “ [I value] the access to walking and swimming amenity. [There is an] opportunity to teach people about dune formation and biodiversity on the beach. [There is also an] opportunity to teach people about the role of dunes and climate change” Participant, Focus Group 2.

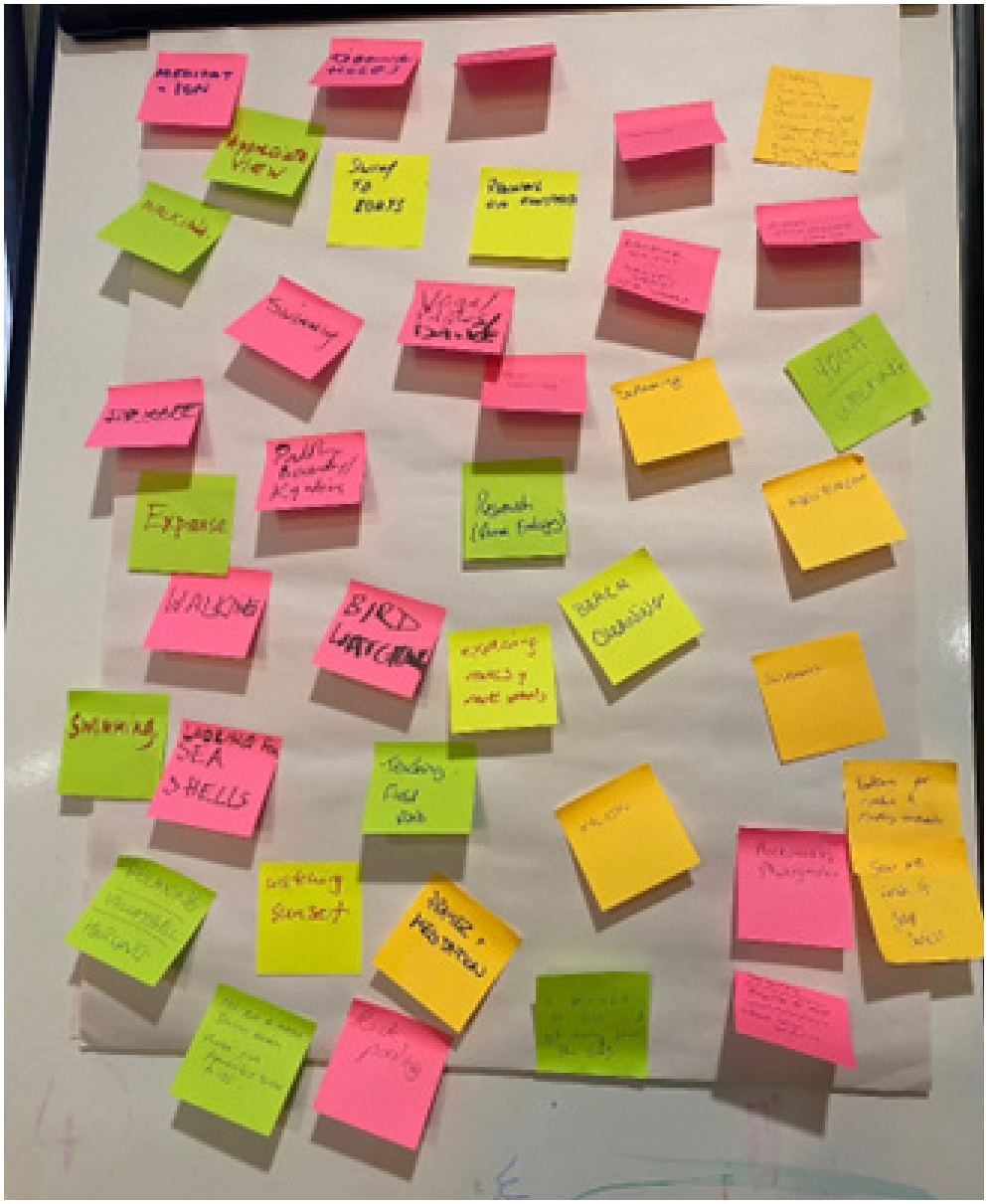


Figure 5 Photograph of the stakeholder feedback gathered

The challenges & opportunities

Ninety-one comments were received relating to the challenges and opportunities associated with Grattan Beach. The seven key emerging themes were:

1. Habitat degradation
2. Addressing societal challenges
3. Seaweed management
4. Facilities and amenities
5. Access and accessibility
6. Education, engagement, and awareness
7. Management

Most responses related to facilities and amenities (30 responses), with access and accessibility (22 responses) being the second most frequently occurring theme.

Grattan Beach

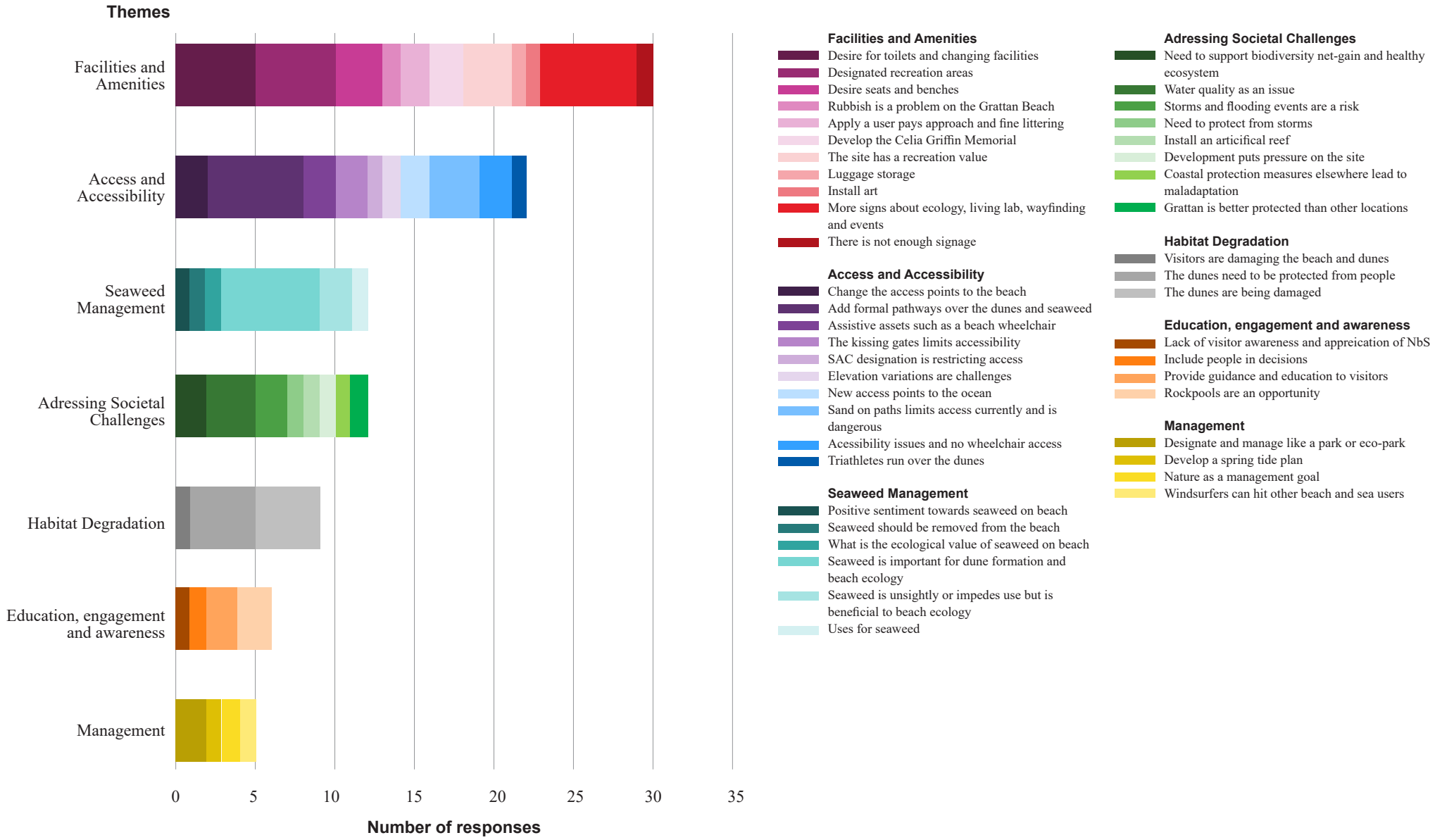


Figure 6 Thematic analysis of the opportunities and challenges for Grattan Beach identified by stakeholders

The following comments captured several of these themes:

> "The views, [the] proximity to the city and [the] habitat, make this a standout site. I think with sustainable management this beach could be a great example of how an urban beach can be used for recreation and raising awareness on fragile coastal habitats." Participant, Focus Group 2.

> "Solutions: Design it like a park (distinct boundaries; code of conduct; education; signage); event planning for summer when huge numbers of visitors in short time periods; have a distinct brand." Participant, Focus Group 3.

> "Observations from an elderly resident [participant self-identified] – 1) the dunes have increased in the past 40 years, 2) Appearance of shoreline as dirty due to seaweed on rocks. This occurs because the city to collect seaweed/dump it nearby which is eventually brought back by the tide".

> "Seaweed – good for erosion but unsightly and attracts flies and takes up the leisure area".

Five sub-themes emerged as dominant, occurring in stakeholder comments five of more times, outlined in Table 2. Each emerging sub-theme related to a potential opportunity.

Table 2 Key sub-themes emerging from the analsysis of comments relating to challenges and opportunities for Grattan Beach

Theme	Sub-theme	Number of responses
Facilities and Amenities	Opportunity for more signs about ecology, the Living Lab, wayfinding and events	6
Facilities and Amenities	Opportunity to install toilets and changing facilities	5
Facilities and Amenities	Opportunity to create designated recreation areas	5
Access and Accessibility	Opportunity to add formal pathways across the dunes and the seaweed	6
Seaweed Management	Seaweed is important for dune formation and beach ecology	6

Vision for the Grattan Beach and measuring success

Seventy-seven comments were received relating to the vision for the Grattan Beach and metrics of success. Analysis of these comments found there to be five emerging themes:

1. Community engagement
2. Structure and quality of the ecosystem
3. Access to the Grattan Beach
4. Use of the Grattan Beach
5. Maintenance and management

Figure 7 presents the findings of the thematic analysis. Community engagement was the most commonly occurring theme, followed by structure and quality of ecosystems.

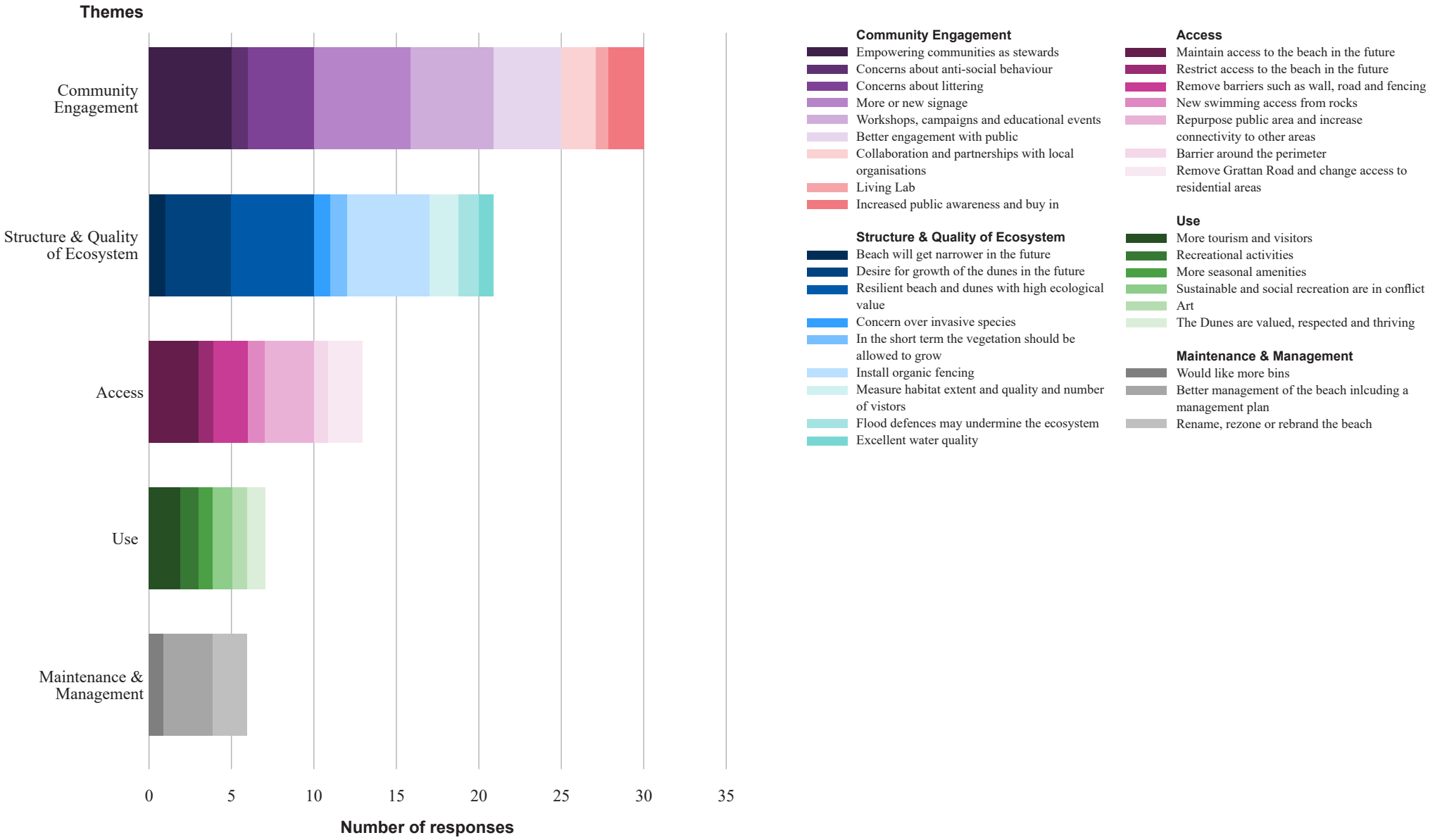


Figure 7 Thematic analysis of stakeholder comments relation to visions for Grattan and how to measure success

Amongst the comments received were the following:

> "Long term vision - change access points into residential areas", "long term vision – get rid of Grattan road".

> "It is a Blue Flag awarded site. Water quality is consistently excellent. Seaweed is left on the beach. The Dunes are valued, respected and thriving."

> "Public engagement using existing campaigns such as Protect our Dunes, and local strengths such as the aquarium to convey the message about the importance of dunes. Involving the local community at every step of the process." Participant, Focus Group 2.

> "[My vision is for] more educational activities focused on the importance of the dunes, including the organisation of workshops about nature-based solutions to erosion involving schools and local communities."

The analysis found five dominant emerging sub-themes. Each of the dominant sub-theme had five or more comments clustered within it. Table 3 presents the dominant sub-themes.

Table 3 Most frequently occurring sub-themes from analysis of comments relating to vision and measuring success

Theme	Sub-theme	Number of responses
Community Engagement	Desire for signage	6
Community Engagement	Empowering communities as stewards	5
Community Engagement	Workshops, campaigns and educational events	5
Structure and Quality of the Ecosystem	Install organic fencing	5
Structure and Quality of the Ecosystem	Resilient beach and dunes with high ecological value	5

4. Future Visions

4. Future Visions

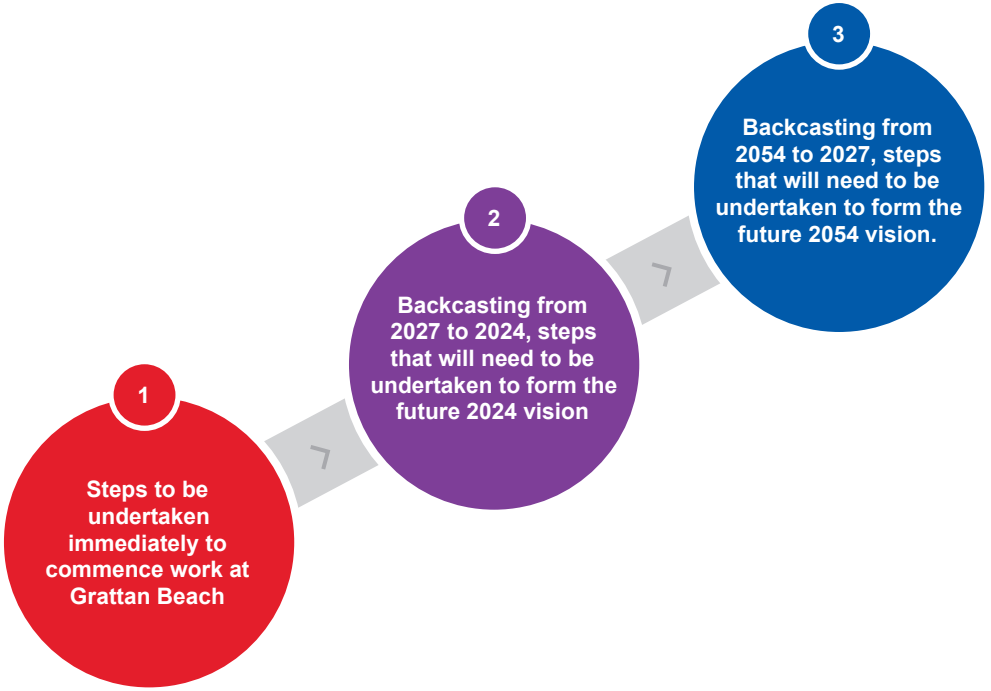
This chapter presents images, narratives, and representations of desired future visions for Grattan Beach. It describes three potential visions which were developed from the discussions on the future vision for Grattan Beach described at the three workshops held with the community and stakeholders of Grattan Beach. The findings of these workshops have been presented in the previous chapter. These visions were developed with the following quote in mind:

> “ The future cannot be predicted, but futures can be invented ”

Dennis Gabor
Winner of the 1971 Nobel Prize in Physics, 1954

It is important to note that achieving some or all of the activities necessary to realise these visions is based on Galway City Council achieving adequate approvals, funding and resources to implement solutions. Future reporting (e.g. CFRAMS) will potentially impact proposals and liaison with key statutory authorities will be necessary.

Using the three “wished for” visions described above this chapter outlines the Roadmap of development that led to these futures. This Roadmap is a back-casting roadmap. The Roadmap addresses the route to the three future visions as follows:



The Roadmap does not backcast 2024 to present day as the situation in 2024 is similar to the present and therefore can be considered the baseline.

Table 4 isolates the various elements that come together to form the future visions and provides examples and insights into the steps that need to be taken to secure this future.

Future vision: In one year's time…

Figure 8 Vision for 2024

Figure 8 presents a vision for Grattan Beach in the year 2024. Environmental responsibility, climate action and resilience will continue to be priorities for Galway City Council. Grattan Beach is used all year round by the community and visitors to walk, swim, and play.

During the winter months, seaweed covers the lower shore. A birdwatcher observes the seabirds feeding on critters in the seaweed and a group of friends play frisbee. Local community groups organise a beach clean-up to collect the plastic and debris that gets washed onto the Grattan Beach during storms. Litter and debris are put in the bins near the entrance to Grattan Beach and collected by the City Council.

By summertime, the tide has washed away a lot of the seaweed and children build sandcastles on the Grattan Beach. Throughout the summer, marine biologists organise a series of seashore safaris, these are attended by adults and children, both locals and tourists, excited to explore the rock pools and animals that live there. Throughout the year, the beach and dunes become an outdoor classroom for marine biology students to study dune ecology and Nature-based Solutions, fostering two-way academic collaboration between the community and schools and universities.

The events and activities organised on the Grattan beach help to cultivate a growing sense of community. Concerns about environmental degradation, extreme weather events, flooding of homes, and accessibility, have led the City Council to develop a Beach Management Plan.

Restoring the dune ecosystems is a priority on the agenda for Grattan Beach. Customised way-finding signage now deters people from walking over the dunes and explains how human and natural factors lead to erosion. An information board helps visitors identify the flora and fauna, including native sea couch and sea rocket.

Through liaison between the community and the City Council the access routes have been redesigned to improve access to the Grattan Beach. Incorporating accessibility into the design and management of the beach is a priority.

Chestnut paling fencing has been installed on Grattan Beach to encourage sand to build up and embryonic dunes to develop. A new Seaweed Management Plan considers the local conditions and management considerations for the seaweed that washes ashore. Whenever possible the seaweed is left in place to provide places for sand to collect which will help to build the beach and dune and creates food and habitats for a variety of species.

Table 4 2024 Roadmap – Immediate Actions*

Opportunity Name	Description
Initiate Living Lab	Take initial steps to establish the Living Lab. Engage with local community to formalise their input to ensure ongoing support and success.
Beach, Dune and Seaweed Management Plan	Develop a Beach, Dune and Seaweed Management Plan including invasive species management and monitoring; water access points. Update current seaweed management plan and strategy to ensure it supports both biodiversity and human wellbeing. Examine impacts of current plan to ensure lessons learnt are incorporated into the new plan. Beach management plan to include review of current seaweed management and impact on biodiversity/habitats
Chestnut paling fencing	Undertake scoping exercise to plan appropriate configuration of fences (number of rows places; orientation to the shoreline).[14] Install fencing. Maintain fencing. Regularly evaluate the efficiency of the fences.
Signage and Wayfinding	Ensure that visitors to the Grattan Beach are provided with the information they need to use the beach sustainably and responsibly. Examples – Provide information on the embryonic dunes and caution against damaging them – Identify with a flag or sign that the beach is accessible – Provide signs about the species that may be observed on the beach
Partnerships, campaigns, and collaborations	Connect with other projects and initiatives relevant to the Grattan Beach Living Lab both in Ireland and beyond. Example: – Local campaigns such as #ProtectOurDunes – EU Projects such as Connecting Nature[16] – Like-minded international activities such as UNESCO World Ocean Day

*All actions are dependent on resources, funding, planning constraints and relevant policy and strategy.

Grattan Beach

Future vision: In three years' time…

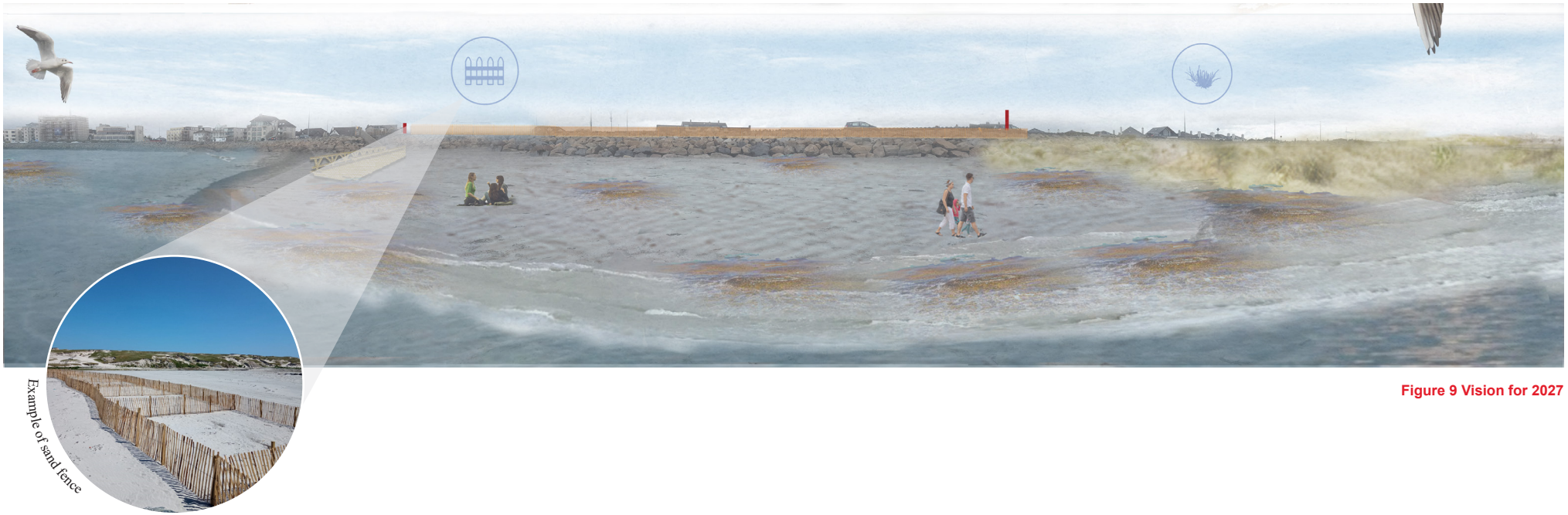


Figure 9 Vision for 2027

Figure 9 presents a vision for Grattan Beach in the year 2024. The community around Grattan Beach is inclusive and diverse. They value the sustainable lifestyle opportunities the area has to offer. Grattan Beach is a place that brings the community together and is at the centre of cultivating a sense of community.

Climate change is apparent to the Grattan community and is the subject of community meetings. The average temperatures in summer are rising, storms are getting stronger and more frequent, and flooding from storm surges and big waves is more common. These trends are set to continue so the community have come together to ensure they are aware and prepared for these changes in climate. The focus is on solutions to erosion and flooding and developing a healthy habitat with a sustainable shared use.

Climate change is integrated into the policies, plans and programmes that impact Grattan Beach. Where possible Nature-based Solutions are preferred but, in some instances, infrastructural adaptation such as building sea defences to deal with higher sea levels, storm surges and higher waves are necessary. Success from previously installed Nature-Based Solutions see the Grattan Beach highlighted online and within the media as a national demonstration site.

There is a calendar of green events such as public talks on environmental and climate issues, conservation projects and beach clean-ups to bring people together and help improve the environment at Grattan Beach. Fostering partnerships with the local area through existing campaigns and resources such as the Aquarium.

There is a high level of community engagement, from young and older, including birdwatching, art and yoga classes. The ongoing relationship with academic institutions sees the continued use of the Grattan Beach for teaching and forming alliances.

Table 5 2027 Roadmap – Medium Term Actions*

Opportunity Name	Description
Ongoing Activities	Regularly monitor and assess ongoing activities. Examples – Review Management Plans on an annual basis – Ensure Living Lab is functioning as anticipated – prepare annual report on progress.. Solutions will evolve based on evidence gathered from implementation.
Seaweed Management Plan	Update current seaweed management plan and strategy to ensure it supports both biodiversity and human wellbeing. Examine impacts of current plan to ensure lessons learnt are incorporated into the new plan.
Removal of kissing gates	Removal of kissing gates to be included as part of GCC's Access Control audit and feasibility of their replacement as per NTA Guidelines 2022 will be considered.
Bins	Provide additional signage to existing public bins.
Seating and benches	Consider accessible seating and benches.
Review existing automatic public convenience infrastructure and determine if adequate	Review existing network of public convenience provided and determine if additional public services are required.[15]
Local Climate Ambassadors	Create opportunities for locals to support the maintenance and management of the Grattan Beach, it's facilities and eco-tourism. Example – Local Climate Ambassadors involved in voluntarily monitoring beach activities, conducting visitor surveys, providing weather and beach updates on social media, coordinating environmental education activities and submitting collated data to the GCC Environmental Awareness Officer.
Forums	Galway City Council holding forums to address issues relating to Grattan Beach. Every citizen, business, public body, and researcher will be able to actively contribute and will be able to report proposals, projects, and best practices.
Focus Groups	Aimed at stakeholders to gather proposals ideas opinions and suggestions for Grattan Beach.
Webinars	Intended for the whole Galway City Coastal communities to increase the wealth of knowledge about climate change . Ensure awareness of already established events. Use the Galway City Council and CARO websites to promote events.
Partnerships, campaigns, and collaborations	Cooperate closely with research centres and third level institutions in Galway.
Environmental education activities	Organised on the Grattan Beach local green activities or initiatives related to education, health, sanitation, and infrastructure. Examples – Workshops for children aged 3 to 12 and adults about anti-drowning and safety procedures. – Talks by an educator about the natural environment, biodiversity, nature based solutions, litter and climate action for adults with mental disabilities and participants undertake a beach cleaning activity
Initiatives for sustainable communities	Support initiatives for sustainable healthy community development and wellbeing. Raise awareness through beach and sea safety activities. Support beach activities that promote active lifestyles and social wellbeing. Examples – In collaboration with HSE a wild swimming group – Health walks – A Little Free Library – a community gathering spot to facilitate free exchange of books
High standard of environmental quality	Create a clean and healthy environment for people and planet.

*All actions are dependent on resources, funding, planning constraints and relevant policy and strategy.

Table 5 2027 Roadmap – Medium Term Actions*

Opportunity Name	Description
Local Authority participation in relevant educational and training actions and workgroups	Enhance the Local Authorities capacity to manage the Grattan Beach more sustainably and implement Nature-based Solutions.
Support and empower gender equality	Ensure an equitable beach provided for all.
Use resources sustainably and promote responsible consumption	Encourage sustainable management and efficient use of natural resources in coastal areas. Example – Consider installing a water tap next to Grattan Beach to help avoid single use plastic on the beach
Create a strong local network for cooperation and bridge the gaps between public sector, private sector, NGOs and community.	Cooperation and partnerships between multiple stakeholders from public, private and NGO sectors at various levels.
Stakeholder education and engagement	Develop innovative education and science programs that allow for inclusive hands-on research activities and place-based education. Example: – 'Summer Institutes' for teachers and Local Authorities. Bring together Galway City teachers or officers from Local Authorities across Ireland to explore Grattan Beach through the lens of coastal erosion, climate change, place-based learning, and science. Allow participants to learn from local experts about climate resilience and coastal erosion work happening at Grattan Beach; to discover opportunities for students or their Local Authorities; and learn how to bring Nature-based Solutions to the classroom or Local Authority. Facilitate the exchange of knowledge and innovation among different actors through the organisation of workshops, lectures, community meetings, and site visits. Example: – Creation of a working group on coastal erosion – Publish a quarterly schedule of education and engagement activities that are available. – Provide a webpage and tools for information, exchange of experiences and outreach for both those participating in the Living Lab and the broader public. Promote the Grattan Beach community becoming an ocean-literate society as the UN's Ocean Decade of Ocean Science for Sustainable Development.[17] Example: Collaborate with the Irish Ocean Literacy Network.[18] – Collaborate with the Irish Ocean Literacy Network.[18] Develop education materials for school lessons to help National and Secondary school students reconnect with the Galway City coastline. Example – The Stone Living Lab has designed activities for Boston Harbour that can be adapted to the Grattan Community context.[11]
Disseminate solutions	Disseminate solutions tested and demonstrated at the Grattan Beach Living Lab so that they were widely known and can be accessed by people beyond the Galway City Area.

*All actions are dependent on resources, funding, planning constraints and relevant policy and strategy.

Future vision: In 30 years' time…

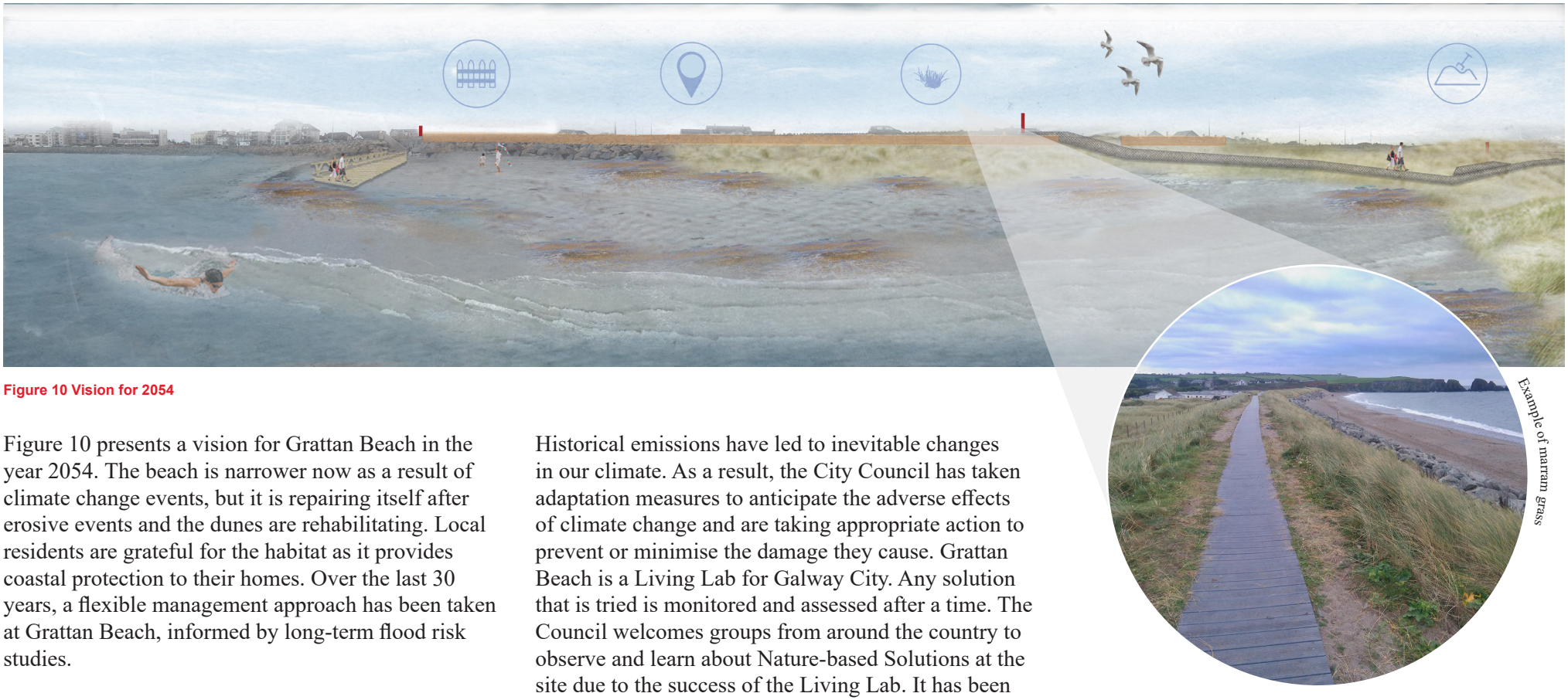


Figure 10 Vision for 2054

Figure 10 presents a vision for Grattan Beach in the year 2054. The beach is narrower now as a result of climate change events, but it is repairing itself after erosive events and the dunes are rehabilitating. Local residents are grateful for the habitat as it provides coastal protection to their homes. Over the last 30 years, a flexible management approach has been taken at Grattan Beach, informed by long-term flood risk studies.

Historical emissions have led to inevitable changes in our climate. As a result, the City Council has taken adaptation measures to anticipate the adverse effects of climate change and are taking appropriate action to prevent or minimise the damage they cause. Grattan Beach is a Living Lab for Galway City. Any solution that is tried is monitored and assessed after a time. The Council welcomes groups from around the country to observe and learn about Nature-based Solutions at the site due to the success of the Living Lab. It has been a fantastic resource, not just for Grattan Beach but the other coastal communities that have benefitted from the insights gained.

Example of marram grass

Table 6 2054 Roadmap – Longer-term Actions*

Opportunity Name	Description
Continued Ongoing Activities	Regularly monitor and assess ongoing activities. Examples – Review Management Plans on an annual basis – Reassess solutions to ensure Grattan Beach continues to be effectively utilised by the local community
Monitor and assess activities of the Living Lab	Continue to monitor and assess activities undertaken as part of the Living Lab and report on the outcomes and experiences. This will include providing feedback on research, innovation, monitoring and stakeholder engagement.
Promote water quality	Achieve high standards of water quality. Examples – Share the water quality data with the public on a digital notice board – Collaborate with marine stakeholders to develop a code of conduct for boat users
Climate action	Raise awareness on climate change and on strategies to reduce environmental footprint. Encourage sustainable management towards all kinds of stakeholders (schools, businesses, public bodies, tourists and local communities). Protect green and blue space and local biodiversity by ensuring healthy ecosystems that contribute to climate change adaptation and mitigation. Examples – Connect schools and private companies to activities on the beach focused on climate and shoreline resilience – Undertake replanting activities on the dunes – Install ocean bins to remove marine waste from the beach to make it possible for volunteers to remove larger pieces of debris that don't fit in regular bins
Improve access routes	Consider developing a continuous unobstructed path that crosses the surface of the beach and access routes must connect an entry point to Grattan Beach to the high tide level at tidal beaches. Consider both permanent and removable access routes. Technical requirements should adequately consider connections, the surface, clear width, obstacles, openings, running slope, cross slope, resting intervals, protruding objects, and dune crossings.
Disseminate solutions - Ongoing	Disseminate solutions tested and demonstrated at the Grattan Beach Living Lab so that they were widely known and can be accessed by people beyond the Galway City Area.

*All actions are dependent on resources, funding, planning constraints and relevant policy and strategy.

5. Conclusion

5. Conclusion

Grattan Beach changes from tide to tide, season to season, and under the influence of the local community as its stewards and guardians. Over time, NbS will be planned, designed, implemented, and monitored, new partnerships will be formed, and new Galway City Council Development Plans will be launched. All of the objectives proposed through the community vision, partnerships and Plans will be implemented and achieved through the establishment of a Living Lab at Grattan Beach.

The level of engagement and support for the stakeholder engagement workshops demonstrates the enthusiasm and commitment of all stakeholders consulted to the future of the beach and dunes. The valuable feedback received has been considered and the views of stakeholders have been incorporated into the future visions imagined for the beach and dunes. GCC themselves have demonstrated commitment to protecting and enhancing the site and will now move forward with efforts to incorporate the feedback received and to develop a management plan for the beach and dunes. This report and the management plan itself will be reviewed and revised regularly to meet the changing needs of the Grattan Beach.

How to update this document

As solutions are tested and stakeholder feedback gathered the reported needs of stakeholders, and the community may change and updates to this Roadmap will need to be made. To stay in alignment with the needs of the community and stakeholders, and the purpose and timeline the Roadmap developed, reflection and learning are important.

GCC should review this Roadmap annually, including a check-in with the purpose, while reflecting on progress, learning and remaining opportunities. The annual review should include a summary of progress made against the opportunities set out for progression in the previous year's summary, assess progress against reaching the transformative Grattan Beach vision described, and a statement on when outstanding opportunities will be progressed. In undertaking this annual review, GCC may invite a learning approach by engaging with a small group of key stakeholders to ask: How are we doing? Are we on track with our purpose and timeline? What challenges are we sitting with? What new challenges are arising? What have we learned? What opportunities are we brining forward to inform the next stage? Is it time for the next participatory engagement?

The annual reviews will help GCC to decide if further engagements are needed and to select specific methodologies for updating this Roadmap. The best methodology will depend on the context of the challenge facing Grattan Beach.

Every two years (or as often as required), GCC should undertake broader engagement with the community and stakeholders of Grattan Beach. Again, inviting a learning approach, the following questions should be considered:

- What have we learned about this Roadmap, about our community, about how we work together?
- What new questions have emerged since we developed these scenarios and the Roadmap?
- What is needed now to keep us moving strategically forwards as a Living Lab?
- What is going well? What needs more attention?
- What has emerged since the last engagement? Is more participatory engagement needed now?
- How have we grown in our ability to learn together with the community and stakeholders?
- What are we not talking about?

6. Next Steps

6. Next Steps

Suggested next steps include:

- Establish a representative working group with stakeholders as detailed in Appendix A.
- Identify work packages
- Agree ownership and responsibility for tasks – the vision should be co-owned by the stakeholders who participated in their development
- Dedicate resources to delivering actions
- Connect to other organisations that share the ambition for Grattan Beach
- Undertake first implementation steps including developing a baseline of dune health

Recommendations

Galway City Council acknowledge the work done for Bertra Beach by the Accelerating Change Together team and have taken inspiration from that work to compile the list below.

Leadership

Find local champions to join Grattan Beach Connected and support the implementation of the vision.

Operations

Employ a dedicated resource - One or more funded part-time positions will have a large imapct on improving the deliverability of the vision programs.

Link to other initiatives - initiatives such as the aim to create a UNESCO Biosphere designation for the Clew Bay have the potential to both contribute and benefit from this vision.

Funding

Utilise the varied stakelholder avenues.

Governance

Establish a Representative Working Group - This is to ensure that there is alignment between the various stakeholder groups and interests.

Collective Ownership - it is recommended that this vision is co-owned by the stakeholder groups that participated in its co-design through the representative stakeholder board.

First Implementation Steps

Measure the Dunes' Health for a defined Period

Find the Easy Wins

Lead by example - The public bodies and specialists groups that have participated in the process of developing the vision have an important role in implementation.

Link to other ogranisations - Connecting to organistations that share the ambitions of this vision, such as habitat restoration will be an effective way tp support the project.

Develop, deploy and evaluate - A flexible and evidence-based approach will be required and should inform any implementation approach.

Leverage Local Funding Potential

Formalise Grattan Beach Connected into a company like CLC to open new avenues for the receipt of funding and supports.

Establish Program Subgroups & Leads - Setting up subgroups for the programs will allow effective delegation and create a more efficient realisation of the program actions.

Clear the Beach and Dunes of debris - return Grattan Beach to a natural state.

Consider Closing the Dunes for a Period

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Appendix A: Stakeholder register

Invitees (Total 31)

Stakeholder	Workshop(s)
Ability West	Non-Government Organisations Workshop (17th November)
Bird Watch Ireland	Non-Government Organisations Workshop (17th November)
Clean Coasts	Non-Government Organisations Workshop (17th November)
Conservation Volunteers Galway	Non-Government Organisations Workshop (17th November)
Fair Seas	Non-Government Organisations Workshop (17th November)
Galway COPE	Non-Government Organisations Workshop (17th November)
Galway Transition	Non-Government Organisations Workshop (17th November)
Galway Water Safety	Government Bodies and Statutory Authorities (24th November)
Irish Wildlife Trust	Government Bodies and Statutory Authorities (24th November)
Sea Search	Government Bodies and Statutory Authorities (24th November)
Volunteer Galway	Non-Government Organisations Workshop (17th November)
Atlantic Technological University (ATU)	Government Bodies and Statutory Authorities (24th November)
Environmental Protection Agency	Government Bodies and Statutory Authorities (24th November)
Failte Ireland	Government Bodies and Statutory Authorities (24th November)
Heritage Council	Government Bodies and Statutory Authorities (24th November)
Housing, Galway County Council	Government Bodies and Statutory Authorities (24th November)
Office of Public Works	Government Bodies and Statutory Authorities (24th November)
Grattan Bay	Local Community & Business Session (7th December)
Green Party	Local Community & Business Session (7th December)
Local Stakeholders (12)	Local Community & Business Session (7th December)

Attendees (Total 40)

Stakeholder	Workshop(s)
An Taisce - The National Trust for Ireland	Non-Government Organisations Workshop (17th November)
Galway Business School	Non-Government Organisations Workshop (17th November)
Irish Environmental Network	Non-Government Organisations Workshop (17th November)
Leave No Trace Ireland	Non-Government Organisations Workshop (17th November)
National Aquarium	Non-Government Organisations Workshop (17th November); Local Community & Business Workshop (7th December)
University of Galway	Non-Government Organisations Workshop (17th November); Local Community & Business Workshop (7th December)
National Parks and Wildlife Service	Government Bodies and Statutory Authorities Workshop (24th November)
Marine Institute	Government Bodies and Statutory Authorities (24th November)
CARO - Mayo	Government Bodies and Statutory Authorities (24th November)
University of Galway	Government Bodies & Statutory Authorities Workshop (24th November); Local Community & Business Session (7th December)
Access 4 All Galway	Local Community & Business Session (7th December)
Curi Ocean (2)	Local Community & Business Session (7th December)
Galway City Council	Local Community & Business Session (7th December)
Glassan Consulting	Local Community & Business Session (7th December)
Heritage Specialists	Local Community & Business Session (7th December)
Local Community Members (7)	Local Community & Business Session (7th December)
National Aquarium	Local Community & Business Session (7th December)
Photographer	Local Community & Business Session (7th December)
Residents (8)	Local Community & Business Session (7th December)
Seapoint	Local Community & Business Session (7th December)
Serve the City	Local Community & Business Session (7th December)
University of Galway (5)	Local Community & Business Session (7th December)

Appendix B: Case Studies

A review was undertaken of Living Labs, NbS and interventions implemented both regionally and internationally to improve coastal resilience and address the impacts associated with changing climatic conditions. A range of projects have been included to demonstrate a variety of measures that may assist the regeneration of Grattan Beach. Learnings from the overall review and lessons learnt from the specific projects were incorporated into the information presented to stakeholders during the workshops to demonstrate both the benefits of NbS and the importance of local community engagement in ensuring the success of the solutions.

A.1 The Stone Living Lab, Boston, Massachusetts

The Stone Living Lab is situated in the Boston Harbour Islands National and State Park, Massachusetts.[11] The Stone Living Lab uses innovative, collaborative approaches to test and scale NbS to address societal challenges including climate adaptation, coastal resilience, and ecological restoration.[11]

The Stone Living Lab is a multi-stakeholder partnership that engages scientists and the local community in research, education, and championing equality.11 The community co-develop solutions to challenges with scientists, including issues around planning, financing, and needs provision associated with NbS.[11]

The projects undertaken include baseline monitoring at Rainsford Island and a pilot project at Fallon Pier at UMass Boston.[11] The Living Lab aims to answer essential questions including:

- How do we choose NbS that will withstand extreme weather conditions beyond what we've previously experienced?
- How can the local community assist in leading the implementation of NbS?
- How do we ensure the solutions we implement are promoting climate justice and targeting inequality?
- What are the emerging solutions for the next generation that we should invest in?
- How do we engage and work with regulators and developers to make the process of permitting and financing streamlined?

More information about The Stone Living Lab can be found here.

A.2 Nature-based Solutions in Ireland

In the Irish context, four interventions were selected:

1. Gurteen and Dogs Bay, County Galway
2. Maherees Conservation Association, County Kerry
3. Line of the Sea, visual light installation across Ireland
4. Bertra Beach, County Mayo

Figure A.1 Map of Ireland showing the location of the four case studies discussed

A.2.1 Gurteen and Dogs Bay, County Galway

Gurteen Beach and Dogs Bay are situated back-to-back (referred to as a 'tombolo') and are located approximately 3km south-west of Roundstone in County Galway. The stretch of beach provides high quality scenic, recreational, and internationally recognised ecological value to the area.

Extensive restoration actions were commenced in the 1990s, these proved successful to the protection of the coastal and degraded dune environment. Following this, a local committee gathered in 2021 and formed the Gurteen Bay and Dogs Bay Conservation Committee. Their aim is to implement a Conservation Management Plan and raise funds to carry out the works. Key restoration tasks include:

- Removing hazardous fencing from the headland
- Installing new chestnut fencing
- Providing clear access pathways that prevent 'trampling'
- Replanting of marram grass.

These interventions aim to prevent direct access and disruption of the 'growing' dunes allowing them to re-establish and stabilise following the establishment of the coastal vegetation. This project is an example of practical community-led conservation. As of July 2022, they had raised just over half of their €70,000 goal.

A.2.2 Maharees Conservation Association, County Kerry

The Maharees is a tombolo located 5km from the Dingle Peninsula in County Kerry. After a series of stormy winters and a high rate of recreational activity on the beach that was compromising its integrity and destabilising the dune system, the Mahareees Conservation Association was founded.

Large quantities of sand were blowing onto the road and impeding access. The repeated blockage of the entrance to the beach was posing a health and safety hazard. Additionally, the disruption to the natural ebb and flow of the dynamic dune systems was threatening the delicate ecosystem. This was of major concern to the local community.

Kerry County Council, technical experts, and members of the community came together to come up with a plan and series of actions to reverse the damage and decrease the rate of coastal erosion at the Maharees.

Since its establishment in 2016, the Maharees Conservation Association has engaged in an expansive range of actions with broad community participation including:

- Beach cleans
- Liaising with council to organise alternative beach access and parking and enforcement measures
- Installation of fencing and planting in fenced areas
- Controlling sand deposition
- Two-way academic/community collaborations with universities
- Biodiversity experiences with themed walks and events
- Customised signage
- Development of artistic interpretations and creative practice to support awareness and build behavioural changes
- Engagement with long-term coastal erosion and flood risk studies
- Sharing knowledge and insights with coastal communities
- Teaching planting and forming alliances.

A Flooding and Coastal Erosion Risk Mitigation Study has been commissioned by the Office of Public Works (OPW) and Kerry County Council forming the fundamental framework for long-term response.

A key intervention has included the introduction of fencing to control and reduce sand deposition and, protect vulnerable areas to encourage regeneration. Experts and specialists identified sand transport pathways, fencing materials were funded by Kerry County Council, and the community installed the fencing. Straw bales and Christmas trees were also placed in 'blow-outs' and used to fill voids throughout the dunes.

The planting of marram grass at five identified 'vulnerable' sites and the management of direct access points to the beach have supported significant regeneration of the dunes.

Collaboration with the University of Galway and Munster Technological University has been integral to the process as a symbiotic relationship. The community supports the educational opportunities of the institution facilitating a living laboratory and living classroom which in turn, generates applied academic research on the restoration and assists in evaluation of the results.

Further information about the Maharees and NbS opportunities can be found here.

A.2.3 Line of the Sea, Ireland

Línte na Farraige (Line of the Sea) is a series of visual light installations projected across key coastal sites throughout Ireland. The project highlights predicted sea level rise based on the Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6 (AR6)12 and historic storm surge data.

Funded by the Creative Ireland Program, it is a creative and collaborative project that has involved artists, scientists, Universities, the Climate Action Regional Offices (CAROs), Galway City Council, as well as designers from Algorithm and Native Events. To ensure minimal environmental impact throughout the installation process, solar panels and renewably powered battery packs have been used and are only turned on during the rising tide.

The project aims to connect the community with the profound changes occurring to the environment, society, and economy because of climate change. Through its starkly simplistic nature, it provides a tangible and visual representation of the risks of rising sea levels. It demonstrates the power of artistic influence and community collaboration in raising awareness, providing education, and promoting the act of responsibility to 'lower the line'.

In Galway City, the horizontal line projections were shown at Spanish Arch. The line of light indicated by Línte na Farraige at Spanish Arch was 1.9m. This indicated the sea level predicted in a storm surge in 2150 when sea levels have risen by 1 metre, this is equivalent to a moderate climate change scenario.

Further information about Línte na Farraige can be found here.

A.2.4 Bertra Beach, Co. Mayo

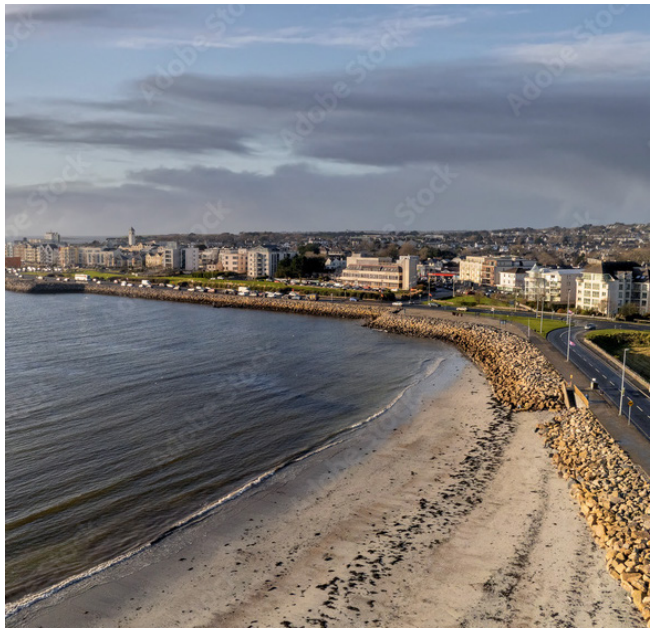
Bertra Beach is situated approximately 12km west of Westport, Co. Mayo. It is encompassed within the wider Clew Bay coastal landscape. The dune system is experiencing erosion along the 4km stretch of beach. The dune system has disintegrated rapidly since a severe storm in 2014 that resulted in Bertra being breached by the Atlantic. Additionally, the extent of Marram grass, the key binding agent and integral stabiliser of the dunes, has reduced coverage by over 60%.

To protect the natural dune system, the first line of coastal defence for Westport Quay and surrounding residential houses, a local community taskforce, Bertra Connected, has established. The taskforce is supported by Mayo County Council and Dr. Kevin Lynch, an environmental scientist from the University of Galway.

Following a series of co-design workshops with participation from various government bodies and local stakeholder groups, the Bertra 2050 Vision Draft Community Stewardship was launched in October 2022. This suggests interventions to protect the dunes and re-establish the marram grass.

Accelerating Change Together (ACT), a social enterprise made up of architects and policy specialists, developed the vision on behalf of Bertra Connected, Mayo County Council and the CARO. It aims to be the blueprint for Bertra's future. Funded by the Heritage Council, the vision presents projects and initiatives that focus on collective stewardship, NbS and innovation for dune regeneration.

Bertra Connected can be found on Facebook, Instagram, and Twitter.



Grattan Beach

A.3 International Nature-based Solutions

This section discusses two international case studies: Dynamic Dunescapes, England and Wales and Barcelona's Hybrid Dunes.

A.3.1 Dynamic Dunescapes, England and Wales

Dynamic Dunescapes is an established organisation that aims to restore dunes across England and Wales for the benefit of people, communities, and wildlife. They work with schools, local groups, volunteers, and visitors. The project centres on nine key dune areas including 34 individual dune sites covering up to 7000 hectares.

Over time, many dunes have become covered by grass and scrub which has led to the sand being over-stabilised, and invasive species have overtaken native ones. Dune ecosystems need areas of free-moving sand and healthy sheltered dune slacks and areas with low vegetation to support native dune species.

Each coastal site was assessed, addressing the unique opportunities and constraints of each beach and dune system. Interventions undertaken have varied widely across the different locations and include:

- Sand dune rejuvenation, including turf stripping to create bare sand, mowing, litter removal, willow and gorse removal, stump removal
- Wetland rejuvenation, including pond creation and restoration
- Invasive species (flora) removal
- Installation of new fencing to facilitate new grazing regimes
- New fencing installed to improve visitor infrastructure
- Print and online media articles, TV appearances, radio interviews, press releases, online public talks
- Temporary signage posters created and displayed for events and physical works
- Engagement activities including birdwatching walks, guided walks, beach and dune art, litter picks, dance classes, geocaching, botanical drawing, and toddler nature sessions
- Events including for dog walkers, older people living with dementia and their carers, and young people
- Education events involving teaching staff, pupils, community members.
- Educator training, skills development for young people, citizen scientists, and sand dune site managers

More information on Dynamic Dunescapes can be found here.

A.3.2 Barcelona, Catalonia

The main project area includes a 14km long beach on the Llobregat delta. Located near the city, this beach serves a population of 64,000 inhabitants who live within 2km and a wider metropolitan population of more than 4 million. The project is supported by the Metropolitan administration of Barcelona. The second project site is 50km south of Barcelona at Calafell, this is promoted city council.

The project aimed to collaborate with local government and stakeholders to construct and maintain semi-fixed dunes on heavily used urban beaches. Catalan beaches are experiencing the negative effects of urbanisation and erosion. Ultimately, if the beach function was to be lost this would have a significant impact on the real-estate and tourist-linked economy.

The project aimed to

- Construct and maintain semi-stabilised dune ecosystems
- Use stakeholder mapping and social research to shape social attitudes to towards sustainable recreation and the protection of dunes

Figure A.2 Map of the World showing international Nature-based Solutions Case Studies

The project included the following interventions:

- Engineering and planning dunes with Ammonphila arenaria
- Undertaking an operational analysis of ecosystem services
- Social valuation
- Stakeholder mapping
- Economic valuation including Cost Benefit Analysis
- Assessments to understand the impact on natural capital and ecosystem services of actual and potential changes in state (i.e. using Toolkit for Ecosystem Services Site-based Assessment)

More information about Barcelona's Hybrid Dunes can be found here.